K Speeding up

Book answers

K1 Racing

Green

a Wednesday
b Carolyn's
c 10 m/s
1 **a** 100 metres
b 40 seconds
2 5 m/s
3 0.1 m/s

Red

a **i** 0.28 m/min
ii 2096 times faster.
b Set up the running track marked out in metre intervals. Put the video camera to record both Susan's running on the track and a stopwatch in the same frame. Her distance run can then be combined with the stopwatch reading to give her speed at any point.
c **i** Two periods of acceleration.
ii Two periods of deceleration.
1 **a** 10 m/s
b 100 m
c 40 seconds
2 **a** Two. There are two short sharp periods of acceleration.
b **i** 0.167 km/min
ii 10 km/h
c B
d A
e C

K2 Measuring speed

Green

a Yes. The wheel is easiest to use for a large distance.
b The stopwatch is most precise because it can measure in hundredths of a second.
c The times they were measuring were very short times. The precision needed was within hundredths of a second and the normal watch would not show the times with enough precision.
1 Repeating measurements and taking a mean ... gives a more reliable value.
A stopwatch is more precise ... than a clock with only two hands.
To measure speed you need to measure ... both distance and time.
2 84 706 seconds, 1412 minutes, 23.5 hours, a day.
3 **a** A
b Individual answers.

Red

a Yes. The wheel is easiest to use for a large distance.
b Their calculations are correct.
300 m ÷ 0.95 s = 316 m/s.
c Their calculations are correct.
d **i** 72 km
e **ii** 300 000 km/s
1 84 706 seconds, 1412 minutes, 23.5 hours, a day.
2 D
3 **a** 308 m/s
b **i** The mean (average) value would be more reliable.
ii The value would be more precise.
iii The value would be more accurate.
iv The value would be more precise.

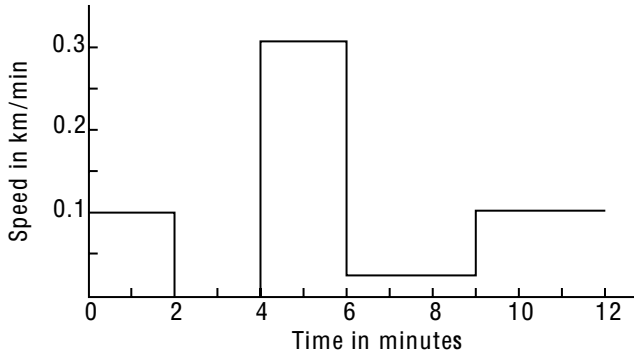
K3 Changing speed

Green

a **i** 8 metres
ii 8 m/s
b If he hit another player or the wall. The backward force would be even greater.
1 **a** You travel at a steady speed when you do not slow down or speed up.
b You slow down when there is an unbalanced force backwards.
c You speed up when there is an unbalanced force forwards.
d A distance–time graph shows a steady speed when the line is straight with a constant gradient.
2 **a** 25 N
b forwards
c Speeds up.

Red

a The gradient (slope) of the line would be steeper.
b His acceleration will not be as great on the second day.
c Lorries have greater masses than cars and need larger engines to produce enough acceleration.
d If he hit another player or the wall. The backward force would be even greater.
e A lorry needs more force to slow it down. The larger the mass, the harder to slow down.
1 **a** 25 N
b forwards
c Speeds up.
2 **a** Between 4 and 6 minutes.
b Between minutes 2 and 4.
c 0.1 km/min
d



K4 Faster!

Green

a **i** thrust **ii** Air resistance.
b The air resistance balances the thrust.
c They can swim very fast and escape from predators.
1 The pushing force of the engine ... increases with speed.
Air resistance and drag are ... types of friction.
Friction acts in the opposite direction ... to the movement of the vehicle.
Maximum speed is reached when ... thrust and friction are balanced.
Air resistance and drag are ... types of friction.
2 **a** A – speeding up.
B – slowing down.
C – steady speed.
b A, C, then B.
3 The smooth surfaces reduce drag (air resistance).

Red

a The faster an object moves the more air particles it meets in a given time. The more air particles the object hits the more the friction and air resistance.
b The thrust of the engine in a forward direction is equalled by the force of air resistance in the backward direction.
c They can swim very fast and escape from predators.
d When the car is streamlined the backward force of air resistance is lower. The amount of thrust needed to equal the reduced air resistance will therefore be decreased.
e Less thrust requires less power from the engine and less fuel will be consumed.
1 **a** A – speeding up.
B – slowing down.
C – steady speed.
b A, C, then B.
2 **a** Particles in the air are spread out with empty space between them. This causes a small drag on the hydrofoil since it hits relatively few particles. The thrust needed is therefore relatively small compared to the boat because particles in liquid water are packed closely together. This causes a large drag and the boat needs more thrust to be able to push through the water.
b The streamlined shape causes the air particles to bounce off at an angle as the 'boat' shape cuts through the air. In the 'boxy' shape the air particles hit the surface flat on and produce maximum resistance.

K5 Slow down

Green

a So it can go faster.
b So it can stop more quickly.
c The open parachute has a large surface area and catches a lot of air. Before it opens the skydiver has only a small surface area and therefore a small air resistance.
d In water the particles are very tightly packed together compared with air. Water particles are also heavier than air. Therefore a large ship travelling in water hits many more heavy water particles and produces much more friction than a comparatively small car hitting air particles.
1 **a** B, C, A.
b The skydiver's area hitting the air is least in B, more in C and most in A when the parachute is open.
2 **a** 250 m
b 50 m/s
c No. The distance-time graph is a straight line. She falls the same distance each second.

Red

a The racer wants to minimise the air resistance so that the car will go faster during the race but maximise the air resistance so the car will stop quickly.
b

	Event	Resultant force	Acceleration
1	exits plane	1000 down	accelerating
2	begins fall	400 down	accelerating
3	free fall	0	steady speed
4	parachute fully open	1000 up	decelerating
5	parachute fully open	600 up	decelerating
6	parachute fully open	0	steady speed

c The brake pads get very hot and the carbon is burned off as carbon dioxide gas.
1 **a** The air resistance of the parachutist.
b The parachutist's weight.
2 Between 5 and 19 seconds, and between 30 and 50 seconds. During both these periods the speed is constant, so the upward force is equal to the downward force.
3 **a** Accelerating between 0 and 5 seconds.
Decelerating between 19 and 30 seconds.
4 When the parachute is open it has a large surface area, so it gathers in many air particles which slows it down. When the parachute is closed the surface area of the parachutist is relatively small. Fewer air particles hit the parachutist so the air resistance is small.
5 When the parachute first opens, the parachutist is falling fast. Many air particles are gathered in by the fast moving parachute and the air resistance is very high. As the parachutist slows down, fewer and fewer air particles are gathered into the parachute. The air resistance becomes less and a steady speed is reached.